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## Dietary Supplement Use Associated with Air Force Fitness and Deployment Health

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Dietary Supplement Use Associated with Air Force Fitness and Deployment Health

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Master of Public Health

### **Acknowledgments**

I would like to express my gratitude to the faculty of the Wright State Boonshoft School of Medicine, Master of Public Health Program. Particularly Lori Metivier for helping me get started, Dr. Mark E. Gebhart for keeping me inspired and Dr. Sara J. Paton for helping me finish. I would also like to thank the outstanding folks at the Air Force Epidemiology Consult Service who have supported me the whole way. Especially Mr. Greg Wolff, who helped make this project possible. Finally, I would like to thank my wife, Suzanne and my daughter Courtney who have always supported and encouraged me; they are my reasons for everything.

The views expressed are those of the author and do not necessarily reflect the official policy or position of the Air Force, the Department of Defense, or the U.S. Government.

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### **Abstract**

**Objective:** This study characterizes supplement use among United States Air Force members as well as attempts to identify an association between supplement use and Air Force Physical Fitness Test (AFPFT) scores or self-reported deployment health.

**Methods:** The study population (n = 24,020) was comprised of Airmen who completed a Web Based Preventive Health Assessment (WebPHA), Post Deployment Health Assessment (PDHA) and completed an AFPFT within six months of their WebPHA. Binary logistic regression was performed to predict AFPFT scores and deployment health outcomes based on supplement usage. Chi-squared analysis was performed to determine if there is any significant association between self-reported supplement use and having an AFPFT score  $\geq 75$  or seeking medical care during deployment.

**Results:** Majority of the population (79.9%) reported using dietary supplements of some kind. Enlisted members, overweight and obese members were more likely to report supplement use than officers and normal weight members, respectively. Nutritional supplement users were 43% more likely to obtain a composite score ( $\geq 75$ ), while diet/weight loss supplement users were 51% less likely to obtain a passing score. Specific types of supplements were associated with increased odds of seeking medical care, however overall supplement was not associated with passing the AFPFT or seeking medical care during deployment.

**Conclusions:** A large portion of Airmen report using dietary supplements. This study did not find a significant association between overall supplement use and improved physical performance, reflected on the Air Force Physical Fitness Test or improved health, indicated by fewer medical visits during deployment.

*Key words:* Dietary Supplements, Air Force, Deployment Health, Fitness, WebPHA

### **Dietary Supplement Use Associated with Air Force Fitness and Deployment Health**

Dietary supplements are intended to supplement one's diet with the needed nutrients required for health and performance. They include vitamins, minerals, herbs, botanicals, amino acids and enzymes. In the United States it's estimated that over 50% of adults use dietary supplements (Carvey, Farina, & Lieberman, 2012). Dietary supplements may be utilized to amend for a poor diet, improve overall health, increase muscular strength, boost energy or enhance physical performance; however, in many cases there is no scientific evidence that these products provide any positive benefit whatsoever.

Supplement use in the military is known to be widespread. Knapik and colleagues (2014) found that among military men 53% to 61% reported supplement use and military females ranged from 66% to 76% (Knapik et al., 2014) (Knapik et al., 2014). Military personnel often find themselves working in hostile and austere environments that require intense prolonged activity. These conditions may put them at increased risk for fatigue, illness and injury. As a result, military members may look to dietary supplements to maintain a high level of health, increase strength and energy. If supplement use can improve physical performance and overall health, then this relationship can be examined by reviewing United States Air Force supplement use, and its relationship to Air Force Physical Fitness Test Scores and Post Deployment Health Assessments.

### **Statement of Purpose**

The purpose of this research study is to assess the self-reported rates of routine supplement (herbal therapy, megavitamin therapy, nutritional supplements, special diet programs for weight loss, and performance enhancers) use among Air Force members. The study aims to analyze the demographics of those who self-report using supplements opposed to those who do

not report supplement use. Finally, the study aims to evaluate if there is an association between self-reported routine supplement use and obtaining a passing score on Air Force Physical Fitness Test (AFPFT), defined as a composite score of  $\geq 75$ , as well as fewer self-reported medical visits during deployment. The results of this study will provide a better understanding of self-reported supplement use and outcomes associated with this usage among Air Force members.

### **Literature Review**

The U.S. Food and Drug Administration (FDA) defines dietary supplements as vitamins, minerals, and additional substances to include herbals, botanicals, amino acids, and enzymes (FDA, n.d.a). These products are defined and regulated by the Dietary Supplement Health and Education Act of 1994 (DSHEA), through the Office of Dietary Supplements within the National Institute of Health. Although these products are regulated, the U.S. government does not approve new supplements before they go to market. If a product contains a new ingredient, the FDA will evaluate that ingredient for human safety, not effectiveness (FDA, 1995). Additionally, the FDA regulates labels on dietary supplements to ensure that they are truthful and not misleading. Manufacturers cannot claim to treat, cure or prevent any particular disease, however, they can make health claims, nutrient content claims, and structure/function claims. A health claim characterizes the relationship between dietary supplement and a reduction in risk of a disease or health condition. Nutrient content claims characterize the amount of a particular nutrient in a product and a structure/function claims describes the products function on a particular organ or system (FDA, 2013).

Despite the minimum regulations concerning the claimed benefits of dietary supplements, DSHEA does not require companies to gain approval from the FDA before marketing dietary supplements. The FDA states on its website that it is the company's responsibility to make sure that its products are safe and that any claims are true (FDA, n.d.a). As a result, scientific

evidence of the benefits of consuming some of these dietary supplements is deficient (Quinones, Winsor, Patino, & Hoffmann, 2013). Garcia-Cazarin, Wambogo, Regan, and Davis (2014) stated, “Less than one quarter of supplements used by adults are recommended by a health care professional, and their effectiveness is often questionable” (p. 414). Dietary supplements are hardly innocuous and they have been associated with health complications. The FDA states “many supplements contain active ingredients that have strong biological effects in the body. This could make them unsafe in some situations and hurt or complicate your health” (FDA, n.d.b). Not surprisingly, taking dietary supplements has been associated with negative health outcomes.

Reporting adverse events associated with supplement use is required for manufacturers and encouraged for consumers. The FDA can only remove the product from market once it has proved that the product presents a significant or unreasonable risk of illness or injury (FDA, 1995). Manufacturers have the primary responsibility for safety of dietary supplements, and significant adverse events have been reported. The FDA estimates there have been greater than 50,000 adverse events in the U.S. associated with dietary supplements (Cassler et al., 2013). This number is likely to grow with increased supplement use. A report by the Substance Abuse and Mental Health Services Administration identified a tenfold increase in emergency room visits due to pre-workout supplements. Approximately 56% of those admissions were associated with energy drink consumption, with reported adverse effects including arrhythmias and high blood pressure. The study concluded that pre-workout products are of significant concern because they contain Central Nervous System (CNS) stimulants in undisclosed amounts. The lack of information on active ingredients of proprietary blends increases the risk for the adverse



health effects and overdosing. Additionally, the safety of these products is generally unknown when consumed in larger than recommended amounts or with other products (Eudy et al., 2013).

The FDA's regulatory approach, which is reactive rather than proactive, has created a significant amount of problems. Even if the FDA identifies products on the market that are unsafe, they are ineffective in mitigating the hazard for consumers. In early 2012, the FDA issued a warning letter to manufacturers of 16 products that contained dimethylamylamine (DMAA), after 40 adverse events and two deaths were reported (FDA, 2012). A study conducted later that year found that despite the risk to health and safety, all of these products were still readily available for purchase (Gregory, 2013).

Another example of failure using the current regulatory approach occurred in the case of ephedra. Ephedra containing products were marketed as weight loss products and subsequently removed from market due to health concerns (Eliason et al., 2012). In 2001, ephedra containing products accounted for 64% of all adverse reactions to herbal supplements while representing less than 1% of herbal products sold (Appel et al., 2012). Despite the negative effects of some dietary supplements such as ephedra and DMAA, the popularity of these products continues to grow.

At the time the DSHEA was enacted there were approximately 4,000 dietary supplements on the U.S. market. By 2010, that number had ballooned to an estimated 54,000 different types of dietary supplements on the market, with approximately 1,000 new products annually (Quinones, Winsor, Patino, & Hoffmann, 2013). With more than half the U.S. population estimated to be using dietary supplements, it's little wonder that they have become a \$30 billion industry with an expected 7% growth annually (Bailey, Gahche, Miller, Thomas, & Dwyer,

2013). As demand grows for these products, it is important to understand who is using them and what the motivations are for their use.

Manufacturers make numerous marketing claims regarding dietary supplements. Such marketing claims include improved overall health, enhanced cognitive or physical performance, and increased energy and weight loss (Knapik et al., 2014). These health outcomes are undoubtedly important to the estimated 52% of U.S. adults who reported using dietary supplements regularly (Carvey, Farina, & Lieberman, 2012). In the military, supplement use has been found to be considerably higher. Across the four military services, 53% to 61% of men and 66% to 76% of women reported using supplements of various kinds (Knapik et al., 2014). The most common dietary supplement used by military personnel is multivitamins, followed by protein supplements (Pasiakos, Austin, Lieberman, & Askew, 2013). Previously reported reasons why military members take these supplements include: to improve health (64%), provide more energy (31%), increase muscle strength (25%), and enhance performance (17%) (Maughan, 2013). A meta-analysis of the prevalence of dietary supplement use by military personnel found that among Airmen, the prevalence of overall dietary supplement use is 60% in men and 76% in women. A breakdown of the type of supplements used revealed that 47% of men used multivitamin and/or multi-minerals compared to 63% of women. The prevalence of individual vitamin and mineral supplements was 25% for men and 40% for women (Knapik et al., 2014).

The perceived health benefits of supplements may not be completely unfounded. There are limited studies that support the beneficial claims of many dietary supplements. One randomized trial found that post-menopausal women had a reduced all-cancer risk with calcium and vitamin D supplementation compared to a placebo group (Lappe, Travers-Gustafson, Davies, Recker, & Heaney, 2007). Another study found evidence that users of vitamin E and

multivitamins containing vitamin C were associated with a reduced prevalence of Alzheimer's disease. However, there was no evidence of a protective effect associated with using these supplements alone (Zandi et al., 2004). In Linxian China, supplementation trials were conducted on a nutrient deficient population with high cancer rates. That study found that vitamin and mineral supplementation reduced cancer risk. Specifically, supplementation with combined  $\beta$ -carotene, vitamin E and selenium for 5 years at levels up to 2-times the recommended daily allowance had 13-21% reductions in gastric cancer incidence, gastric cancer mortality, and total cancer mortality (Blot et al., 1993). In a randomized control study in France 13,017 adults were given a daily combination of 120 mg of ascorbic acid, 30 mg of vitamin E, 6 mg of beta-carotene, 100 mg of selenium, and 20 mg of zinc, or a placebo for 7.5 years. There were no significant differences in total cancer incidence between the study group and placebo group. However between men and women, antioxidant supplementation lowered total cancer incidence and all-cause mortality in men but not women (Hercberg et al., 2004).

These findings are in stark contrast to other studies that have not found a correlation between supplement use and positive health outcomes. In fact, some studies have found that supplement use might negatively affect health. Lawson and colleagues (2007) examined the association between multivitamin use and the risk of prostate cancer. They observed no association between multivitamin use and the risk of localized prostate cancer. However, the study did find that excessive use of vitamins compared to those who do not use vitamins had a significant increased risk of advanced and fatal prostate cancers (Lawson et al., 2007). In the Iowa Women's Health Study, the relationship of vitamins and mineral supplements to total mortality was assessed. They found that multivitamin and supplement users had an absolute risk

increase of 2.4%–18% of total mortality when compared with corresponding nonusers (Mursu, Robien, Harnack, Park, & Jacobs, 2011).

Supplement labels often claim to improve physical performance, which may be why 54% – 84% of professional athletes reported supplement use (Grandjean, 1983). Part of the Invecchiare in Chianti (InCHIANTI) study assessed the correlation between antioxidants and physical performance in elderly people (Cesari et al., 2004). This study found that plasma antioxidant concentrations were correlated positively with physical performance and strength. Specifically, vitamin C and  $\beta$ -carotene was significantly associated with knee extension strength, and vitamin C was significantly correlated with physical performance measured by walking speed, ability to rise from a chair, and standing balance (Cesari et al., 2004). Beyond these findings, this study was unable to find significant supporting evidence that supplements improve physical performance. In fact, many studies showed that there is no association.

One study examined the effects of vitamins and minerals supplements on the running performance of trained athletes. This was a placebo-controlled crossover study that measured a 15 km timed run, maximal oxygen consumption, peak running speed, blood lactate turnpoint and peak post-exercise blood lactate levels. The study concluded that after three months of supplementation, none of these variables were affected by vitamin or mineral supplements (Weight, Myburgh, & Noakes, 1988). Additionally, a double blind, placebo-controlled study examining high potency multivitamin-mineral supplements effect on performance was conducted. This study found that after 90 days of supplement use there was no difference in Maximal aerobic capacity, heart rate or performance during a 90-minute endurance run. The study concluded that muscular strength, endurance and physical performance were unaffected by supplements in well-nourished, physically active men (Singh, Moses, & Deuster, 1992).

Similarly, a 4-week randomized, double blind clinical trial was conducted on the effects of vitamins C and E on performance, muscle damage and body composition. They found that VO<sub>2</sub> max, subcutaneous fat and myoglobin levels were not significantly affected by supplements (Taghiyar et al., 2013).

Despite the limited information on the efficacy of dietary supplements, the prevalence of use continues to grow in the United States. A study of reported supplement use in the National Health and Nutrition Examination Survey (NHANES) data from 2003 to 2006 found that 49% (44% of males, 53% of females) of the U.S. population use dietary supplements. The most commonly reported dietary supplement was multivitamin/multi-minerals, with the majority of respondents (79%) taking them daily in the previous month. Additionally, dietary supplement use was associated with 54% of adults. Among this group, the prevalence of use was highest among overweight individuals (57%) followed by normal weight (56%) and then obese individuals (48%) (Bailey et al., 2013). A follow-up study of NHANES data from 2007- 2010 on supplement use was also conducted. Data from the study indicated that the prevalence of supplement use increases with age, ranging from 34% in 20 and 30-year-olds, to 50% in 40 to 59-year-olds and 67% in individuals over 60 years old. Additionally, supplement use was higher among former smokers (59%) than those who never smoked or current smokers, 51% and 31% respectively. Interestingly, supplement users reported a higher rate (55%) of assessing their health to be excellent or very good (Bailey et al., 2013).

Dietary supplement use is commonly associated with physically demanding occupations. Lieberman et al. noted, "U.S. Army soldiers engage in strenuous activities and must maintain fitness and body weight to retain their jobs"(Lieberman et al., 2010, p. 985). They surveyed 990 randomly selected soldiers to characterize supplement use among active-duty Army soldiers.

They found that 53% of soldiers reported using dietary supplements with the most common being multivitamins (37.5%). Additionally, among U.S. soldiers dietary supplement use was associated with higher age, higher education level and higher BMI. The reported reasons for supplement use was to improve health (64%), increased energy (31%), increased strength (25%) and enhanced performance (17%) (Lieberman et al., 2010).

Another study surveyed 16,146 U.S. military personnel to identify health behaviors associated with supplement use for body building, weight loss and performance enhancement. They found that supplement use was more significantly associated with members who were categorized as heavy drinkers and overweight or obese. The commonly report reasons for supplement use in this study were to increase muscle mass, lose weight and improve performance. Additionally, of the members surveyed, <30% discussed supplement use with their healthcare provider (Kao, Deuster, Burnett, & Stephens, 2012).

Air Force personnel may be particularly motivated to use supplements to assist in attaining a passing score on the AFPFT. The AFPFT goal is to promote health and overall fitness and is comprised of a 1.5 mile run, Abdominal Circumference measurement (AC), push-ups and sit-ups. Adjusted for age and gender, the highest possible score is 100 points, which breaks down to 60 points for the run, 20 points for AC, 10 points for push-ups, and 10 points for sit-ups (Worden & White, 2012). Airman must meet the minimum score for each component and at least an overall score of 75 to pass. For example, a male Airman <30 years old must at a minimum complete the 1.5 mile run in 13:36, have an AC no greater than 39", complete 33 pushups and 42 sit-ups in one minute sets. Failing an AFPFT may result in an unsatisfactory performance report and inhibit career progression (USAF, 2013). The impact the AFPFT results have on an Airmen's career may be influential to their decision to use supplements.

## Methods

This study was approved by the Air Force Research Laboratory IRB committee and was determined to be exempt from IRB oversight. Data from the Active Duty (AD) Airmen's Web Based Preventive Health Assessment (WebPHA) from 1 January 2012 to 30 November 2013 was used to identify supplement users (cases) and non-supplement users (controls). These data were then linked to Airmen who completed the Air Force Physical Fitness Test (AFPFT) within the preceding six months as well as a Department of Defense form 2796 (DD 2796), Post Deployment Health Assessment (PDHA). The data was cleaned of personally identifiable information, and study IDs were assigned. Our total study population was comprised of 24,020 AD Airmen.

Study subjects were asked to specify whether they used herbal therapy, high dose/megavitamin therapy, nutritional supplements, special diet programs for weight loss, performance enhancers and/or other supplements. Annual fitness assessment results were collected and then categorized by composite score: *100-90 (Excellent)*, *89-75 (Satisfactory)*, *<75 (unsatisfactory)*. Reported PDHAs were used to assess self-reported supplement use on the WebPHA compared to: overall health in the past deployed month, categorized as *excellent, very good, good, fair, and poor*. Change in health status post-deployment was categorized as *much better now than before I deployed, somewhat better now than before I deployed, about the same as before I deployed, somewhat worse now than before I deployed, and much worse now than before I deployed*, and the number of self-reported medical visits during deployment was categorized as *no visits, 1 visit, 2-3 visits, 4-5 visits, >6 visits*. These are questions 1, 2 and 6 of the PDHA respectively. Population demographics such as age, gender, rank, BMI, and smoking status were examined. Binary logistic regression was performed to examine for an association

between supplement usage and AFPFT scores as well as supplement usage and deployment health outcomes. Additionally, chi-squared analysis was performed to determine if these associations were statistically significant. A p-value of  $<.05$  was considered significant. Results from the binary logistic regression are presented as odds ratios (OR) and 95% CIs. Microsoft Excel 2010 and SAS 9.3 computer software were used to analyze this data. A table of analyzed variables is provided in Table 1.

<b>Table 1. Methods: Variables Analyzed</b>			
<b>Variable Type</b>	<b>Variable</b>	<b>Measurement</b>	<b>Comment</b>
Dependent	Dietary Supplement Use	Y or N	
Dependent	Air Force Fitness Assessment	Pass (Score $\geq 75$ ) or Fail (Score $<75$ )	
Dependent	Seeking Medical Care During Deployment	Seen (Visits $\geq 1$ ) or Not Seen (Visits = 0)	
Independent	Supplement Type	Self-Reported as Herbal Therapy High Dose/Mega Vitamin Nutritional Supplement Diet/Weight Loss Therapy Performance Enhancers Other Supplement	Chi Square Analysis Binary Logistic Regression
Independent	Gender	F or M	Chi Square Analysis Binary Logistic Regression
Independent	Age	$<30$ 30-39 40-49 50-59	Chi Square Analysis Binary Logistic Regression
Independent	Military Category	Officer Enlisted	Chi Square Analysis Binary Logistic Regression
Independent	Body Mass Index	$<18.5$ Underweight 18.5-24.9 Normal 25.0-29.9 Overweight $\geq 30$ Obese	Chi Square Analysis Binary Logistic Regression
Independent	Tobacco Use	Never Used Previous User Current User Non-user	Chi Square Analysis Binary Logistic Regression
Independent	Fitness Test Score	100-90 (Excellent) 89-75 (Satisfactory) $<75$ (Unsatisfactory)	Chi Square Analysis Binary Logistic Regression
Independent	Health in Previous Deployed Month	Self-Assessed as Excellent Very Good Good Fair Poor	Chi Square Analysis Binary Logistic Regression
Independent	Health Vs. Before Deployment	Self-Assessed as Much Better Now Somewhat Better Now About The Same Somewhat Worse Now Much Worse Now	Chi Square Analysis Binary Logistic Regression
Independent	Medical Visits During Deployment	Self-Reported as 0 Visits 1 Visit 2-3 Visits 4-5 Visits $\geq 6$ Visits	Chi Square Analysis Binary Logistic Regression



## Results

The study population contained 24,020 active-duty Airmen who self-reported supplement use status and completed a WebPHA, AFPFT and PDHA between 1 January 2012 and 30 November 2013. Table 2 shows that overall supplement use among this population was 79.9%. Supplement usage was not significantly different among gender ( $p=0.4296$ ) or age groups ( $p=0.4806$ ). Military category, which is significant indicator of household income and an effective military measure of Socioeconomic Status (SES), indicated that enlisted members had 19% increased odds of supplement use versus officers (95% CI 1.10 – 1.28) ( $p<0.0001$ ). Assessment of supplement users by Body Mass Index (BMI) revealed that members who are classified as overweight (BMI = 25.0-25.9) and obese (BMI  $\geq 30$ ) had 1.12 (95% CI 1.05 – 1.21) ( $p=0.0015$ ) and 1.28 (95% CI 1.17 – 1.41) ( $p<0.0001$ ) times the odds, respectively of supplement use compared to normal weight (BMI = 18.5-24.9) members. Interestingly, members who were classified as underweight showed a 68% increase in odds of supplement use compared to normal weight individuals. This increase however was not shown to be statistically significant ( $p=0.4083$ ). Analysis of current and former tobacco users indicated that they had 3% higher odds of using supplements compared to non-tobacco users; however, this increase also did not prove to be statistically significant ( $p=0.4083$ ).

**Table 2. Supplement Use Demographics**

	Population (n=24020)	Supplement Use (n=19187) (79.9%)	No Supplement Use (n=4833) (20.1%)	Odds Ratio (95% CI) <sup>a</sup>	p-Value <sup>b</sup>
<b>Gender # (%)</b>					
Females	3198 (13.3%)	2538 (79.4%)	660 (20.6%)	0.96 (.88 – 1.06)	0.4296
Males	20822 (86.7%)	16649 (80%)	4173 (20%)	Reference	-
<b>Age Distribution # (%)</b>					
<30	15456 (64.3%)	12325 (79.7%)	3131 (20.3%)	Reference	-
30-39	7358 (30.6%)	5897 (80.1%)	1461 (19.9%)	1.03 (.96 – 1.10)	0.4806
40-49	1144 (4.8%)	915 (80%)	229 (20%)	1.02 (.87 – 1.18)	0.8453
50-59	62 (.3%)	50 (80.65%)	12 (19.35%)	1.06 (.56 – 1.99)	0.8615
<b>Military Category # (%)</b>					
<i>Missing Data = 2</i>					
Officer*	4871 (20.3%)	3779 (77.6%)	1092 (22.4%)	Reference	-
Enlisted	19147 (79.7%)	15406 (80.5%)	3741 (19.5%)	1.19 (1.10 – 1.28)	<0.0001
<b>Body Mass Index # (%)</b>					
<i>Missing Data = 15</i>					
<18.5 Underweight	42 (.2%)	36 (85.7%)	6 (14.3%)	1.68 (.71 – 3.99)	0.2395
18.5-24.9 Normal	6957 (29%)	5434 (78.1%)	1523 (21.9%)	Reference	-
25.0-29.9 Overweight	12397 (51.6%)	9922 (80%)	2475 (20%)	1.12 (1.05 – 1.21)	0.0015
≥ 30 Obese	4609 (19.2%)	3781 (82%)	828 (18%)	1.28 (1.17 – 1.41)	0.1870
<b>Previous Tobacco Use # (%)</b>					
Never Used	13272 (55.3%)	10577 (79.7%)	2695 (20.3%)	Reference	-
Previous Tobacco User	10748 (44.7%)	8610 (80.1%)	2138 (19.9%)	1.03 (.96 – 1.09)	0.4267
<b>Current Tobacco Use # (%)</b>					
Non-user	13277 (55.3%)	10580 (79.7%)	2697 (20.3%)	Reference	-
User	10743 (44.7%)	8607 (80.1%)	2136 (19.9%)	1.03 (.96 – 1.09)	0.4083

<sup>a</sup> Odds ratio calculated using logistic regression<sup>b</sup> p-value calculated by chi-square

An analysis of the types of supplements used shown in Table 3 revealed that 19,187 individuals reporting that they used supplements. Some individuals reported using more than one supplement for a total count by category of 20,412 (data not shown). Among the categories to choose from, 62.4% indicated that they use other supplements not listed in the WebPHA. The second most common was nutritional supplements with 13.7% of members reporting use.

**Table 3. Self Reported Supplement Use**

	Supplement Used # (%)	Supplement Not Used # (%)
<b>Overall Supplement Use</b>	<b>19187 (79.9%)</b>	<b>4833 (20.1%)</b>
Herbal Therapy	362 (1.5%)	23658 (98.5%)
High Dose/Mega Vitamin	767 (3.2%)	23523 (96.8%)
Nutritional Supplement	3281 (13.7%)	20739 (86.3%)
Diet/Weight Loss Therapy	298 (1.2%)	23722 (98.8%)
Performance Enhancers	712 (3%)	23308 (97%)
Other Supplement	14992 (62.4%)	9028 (37.6%)

An evaluation of the association of overall supplement use with fitness and deployment health did not reveal a significant benefit (Table 4). Supplement use by fitness test scores

indicated that those in the excellent fitness test score range had 4% higher odds of supplement use than those in the satisfactory score range. Those in the unsatisfactory had 2% lower odds of using supplements compared to those in the satisfactory score range; although, these findings were not statistically significant ( $p=0.1828$ ) and ( $p=0.7737$ ) respectively.

Analysis of self-assessed health in the previous deployed month showed that subjects who identify their health as excellent had 11% (95% CI .81– .98) ( $p=0.0150$ ) decreased odds of supplement use as compared to subjects who perceived their health as good. Interestingly, subjects who perceived their health to be fair and subjects who perceived their health to be poor had 2% and 8% higher odds of supplement usage, respectively, when compared to those who perceived their health as good. However, this was shown to not be statistically significant with  $p=0.8251$ . Self-assessed health compared to before deployment did not indicate any significant odds of supplement use compared to subjects feeling about the same (reference). Subjects who felt much worse now than prior to deployment did have a 23% increase in odds of being supplement users compared to subjects feeling about the same. However, this increase was also shown to not be statistically significant with the  $p=0.4564$ . Additionally, an evaluation was conducted comparing self-reported medical visits, using 0 visits as the reference variable, to supplement usage. Among the study population, 13,509 (57%) reported not seeking medical care, with 10,866 (79%) being supplement users and 2,743 (20.2%) not using supplements. Analysis did not indicate a significant correlation between seeking or not seeking medical care during deployment and overall supplement usage.

**Table 4. Supplement Use By Variable**

	Population (n=24020)	Supplement Use (n=19187) (79.9%)	No Supplement Use (n=4833) (20.1%)	Odds Ratio (95% CI) <sup>a</sup>	p-Value <sup>b</sup>
<b>Fitness Test Score # (%)</b>					
100-90 (Excellent)	12560 (52.3%)	10077 (80.2%)	2483 (19.8%)	1.04 (.98 – 1.15)	0.1828
89-75 (Satisfactory)	10545 (43.9%)	8386 (79.5%)	2159 (20.5%)	Reference	-
<75 (Unsatisfactory)	915 (3.81%)	724 (79.1%)	191 (20.9%)	.98 (.83 -1.15)	0.7737
<b>Self-Assessed Health in Previous Deployed Month # (%)</b>					
<i>Missing Data = 144</i>					
Excellent	9700 (40.6%)	7693 (79.3%)	2007 (20.7%)	.89 (.81 – .98)	0.0150
Very Good	9543 (40%)	7622 (79.9%)	1921 (20.1%)	.92 (.84 – 1.01)	0.0903
Good	4055 (17%)	3290 (81.1%)	765 (18.9%)	Reference	-
Fair	527 (2.2%)	492 (81.4%)	98 (18.6%)	1.02 (.81 – 1.28)	0.8816
Poor	51 (.2%)	42 (82.35%)	9 (17.65%)	1.08 (.53 – 2.24)	0.8251
<b>Self-Assessed Health Vs. Before Deployment # (%)</b>					
<i>Missing Data = 148</i>					
Much Better Now	3751 (15.7%)	2998 (79.9%)	753 (20.1%)	1.02 (.93 – 1.11)	0.7337
Somewhat Better Now	5871 (24.6%)	4706 (80.2%)	1165 (19.8%)	1.03 (.95 – 1.11)	0.4431
About The Same	12780 (53.5%)	10182 (79.7%)	2598 (20.3%)	Reference	-
Somewhat Worse Now	1377 (5.8%)	1109 (80.5%)	268 (19.5%)	1.06 (.92 – 1.21)	0.4474
Much Worse Now	93 (.4%)	77 (82.8%)	16 (17.2%)	1.23 (.71 – 2.11)	0.4564
<b>Medical Visits During Deployment # (%)</b>					
<i>Data Missing = 129</i>					
0 Visits	13609 (57%)	10866 (79.8%)	2743 (20.2%)	Reference	-
1 Visit	5529 (23.1%)	4427 (80.1%)	1102 (19.9%)	1.02 (.94 – 1.10)	0.7253
2-3 Visits	3931 (16.5%)	3150 (80.1%)	781 (19.9%)	1.02 (.93 – 1.11)	0.6913
4-5 Visits	559 (2.3%)	437 (78.2%)	122 (21.8%)	.90 (.74 – 1.11)	0.3358
≥ 6 Visits	263 (1.1%)	211 (80.2%)	52 (19.8%)	1.02 (.75 – 1.39)	0.8778
<sup>a</sup> Odds ratio calculated using logistic regression					
<sup>b</sup> p-value calculated by chi-square					

Further analysis was conducted on the types of supplements used and their association with passing (composite score  $\geq 75$ ) the AFPFT. Table 5 shows the number of subjects who passed or failed (composite score  $< 75$ ) their fitness assessment and whether they used certain supplements types. This table indicates that nutritional supplement users have 1.43 times the odds of passing the AFPFT than those who do not use nutritional supplements. Additionally, diet/weight loss supplement users have 51% (95% CI .32– .76) ( $p=0.0015$ ) lower odds of passing the AFPFT. This is interesting considering that there is no other significant correlation among the supplement types and passing or failing the AFPFT. In fact, overall supplement use was not significantly associated with passing the AFPFT ( $p=0.5621$ ).

**Table 5. Supplement Use Associated With Passing Air Force Fitness Assessment**

	Population (n=19187)	Pass (Score ≥ 75) (n=23105) (96.2%)	Failed (Score < 75) (n=915) (3.8%)	Odds Ratio (95% CI) <sup>a</sup>	p-Value <sup>b</sup>
<b>Supplement Type No (%)</b>					
Herbal Therapy	362	349 (96.4%)	13 (3.6%)	1.06 (.61 – 1.85)	0.8316
High Dose/Mega Vitamin	767	736 (96%)	31 (4%)	.94 (.65 – 1.35)	0.7326
Nutritional Supplement	3281	3189 (97.2%)	92 (2.8%)	1.43 (1.15 – 1.78)	0.0013
Diet/Weight Loss Therapy	298	276 (92.6%)	22 (7.4%)	.49 (.32 – .76)	0.0015
Performance Enhancers	712	685 (96.2%)	27 (3.8%)	1.01 (.68 – 1.49)	0.9806
Other Supplement	14992	14398 (96%)	594 (4%)	.89 (.78 – 1.03)	0.1111
Supplement Users Overall	19187	18463 (96.2%)	724 (3.8%)	1.05 (.89 – 1.23)	0.5621

<sup>a</sup> Odds ratio calculated using logistic regression<sup>b</sup> p-value calculated by chi-square

Additional evaluation was conducted on the types of supplements used and their association with seeking medical care during deployment. Table 6 shows supplement users and non-supplement users who either sought or did not seek medical care.

**Table 6. Supplement Use Associated With Seeking Medical Care During Deployment**

<i>Medical Care data was missing for 96 Supplement Users &amp; 33 Non-users</i>	Population (n=19091)	Seen (Visits ≥ 1) (n=10282) (43%)	Not Seen (n=13609) (57%)	Odds Ratio (95% CI) <sup>a</sup>	p-Value <sup>b</sup>
<b>Supplement Type No (%)</b>					
Herbal Therapy	359	208 (57.9%)	151 (42.1%)	1.84 (1.49 – 2.27)	<0.0001
High Dose/Mega Vitamin	763	414 (54.3%)	349 (45.7%)	1.59 (1.38 – 1.84)	<0.0001
Nutritional Supplement	3264	1583 (48.5%)	1681 (51.5%)	1.29 (1.20 – 1.39)	<0.0001
Diet/Weight Loss Therapy	294	169 (57.5%)	125 (42.5%)	1.80 (1.43 – 2.27)	<0.0001
Performance Enhancers	708	361 (51%)	347 (49%)	1.39 (1.20 – 1.62)	<0.0001
Other Supplement	14914	6145 (41.2%)	8769 (58.8%)	.82 (.79 – .86)	<0.0001
Supplement Users Overall	19091	8225 (43.1%)	10866 (56.9%)	1.01 (.95 – 1.08)	0.7747

<sup>a</sup> Odds ratio calculated using logistic regression<sup>b</sup> p-value calculated by chi-square

Analysis of each type of supplement indicates a correlation with the increased odds of seeking medical care. However, examination of the Other Supplement category (the largest category), showed the odds of seeking medical care are decreased 18% (95% CI .79– .86) (p=<0.0001) for those who reported use. Furthermore, the table shows that overall supplement use when correlated with seeking medical care has an OR = 1.01. An OR =1 indicates that overall supplement use provides no protective factor from seeking medical care or that the odds of seeking care are equal among supplement users and non-supplement users.

### **Discussion**

This study assessed supplement use among Air Force members and their association with fitness and health. In general, this study's findings were in line with the current literature on the effects of supplement use. However, some of the study's findings were unique compared to previous studies. The prevalence of dietary supplement use among Air Force member was nearly 80% overall, with 79% of women and 80% of men reporting supplements use. This is higher than the general U.S. population, estimated to be 49%-52%, (Bailey et al., 2013; Carvey et al., 2012). The prevalence of reported supplement use was slightly higher in this study when compared to previous military studies which estimate 76% of Air Force women and 60% of Air Force men use supplements (Knapik et al., 2014). This higher prevalence may be indicative of the trending popularity of supplement use.

Air Force supplement users did not differ statistically when comparing gender, age and smoking status. This is considerably different than the current literature that indicates a considerably higher prevalence of supplement use among former tobacco users, women, as well as an increase in overall supplement use with age (Bailey et al., 2013). Although not statistically significant, this study found that females were 4% less likely to use supplements and that the prevalence of supplement use remained at approximately 80% through all age groups. Additionally, previous and current tobacco users were found to have a 3% increase in the odds of supplement use. Comparatively, other studies have found that current smokers have a lower prevalence supplement use (Bailey et al., 2013). Given the importance of health and performance, tobacco users in this population may look to supplements to mitigate the negatives health effects of tobacco.

Supplement use among this population was significantly correlated with military category and Body Mass Indices. Military category does not have a civilian equivalent for comparison. In general, military officers have a higher level of education and household income compared to enlisted members. In the current literature supplement use is associated with higher education levels and household income (Timbo, Ross, McCarthy, & Lin, 2006). This study found that enlisted members were more likely to report supplement use. Additionally, overweight and obese members had 12% and 28% increase in odds of using dietary supplements compared to normal weight individuals. This is a common finding in the current literature (Bailey et al., 2013), and may indicative of the appeal of supplements as an easy way address individual struggles with excess weight or unhealthy life styles.

Analysis of fitness test scores among overall supplement users and non-supplement users did not statistically differ. The prevalence of supplement use was nearly 80% for those who scored Excellent, Satisfactory or Unsatisfactory. Further analysis of the individual categories of supplements and their association with passing the Air Force fitness assessment revealed that nutritional supplement users had 43% higher odds of obtaining a passing score and diet/weight loss supplement users had 51% lower odds of obtaining a passing score. Speculatively, nutritional supplement use may be a characteristic of members who puts a high importance on health and is thus a healthy individual. Similarly, members who use diet/weight loss supplements are likely to be overweight or obese which would hinder their ability to pass the AC portion of the test. No other supplement category was significantly associated with passing or failing the Air Force fitness assessment. Overall however, no correlation between supplement use and Air Force fitness assessment scores was observed. These findings are in line with the

current literature that indicates no significant association between supplement use and physical performance.

Analysis of deployment health of data was conducted to identify any association between supplement use and overall health. In this study participants were asked how they perceived their overall health in the previous deployed month. Supplement users were less likely to perceive their overall health as excellent or very good and more likely to perceive their health to be fair or poor. This is considerably different than other studies that find supplement users have a higher prevalence of assessing their health to be excellent or very good (Bailey et al., 2013). This difference is interesting and may lend to the possibility that Airmen may use supplements because they perceive that their health can be better.

Members were also asked to assess their health compared to before deploying and how many times they sought medical care. There was no statistically significant correlation between overall supplement use and, perceived health compared to before deployment. Additionally, no significant was found between overall supplement use and the number of medical visits.

Evaluation of the individual supplement categories seems to indicate that there are higher odds of seeking care for users of herbal therapy, high dose/mega vitamins, nutritional supplements and diet/weight loss therapy compared with nonusers. Interestingly, members who characterized their supplements as “other” had 18% lower odds of seeking care. However collectively, supplement users had an OR of near 1.00, indicating that supplements provide no protective factor and the odds of seeking care are equal between both groups.

## **Limitations**

This study is not without its limitations. The WebPHA data is collected as a survey to tailor preventative care and not fully designed for research. Additionally, the data analyzed in



this study was categorical, limiting the analysis methods. The PDHA is an invalidated method for data collection because members may be reluctant to divulge information that may delay their return to family and friends. Assumptions were made with the data's coding; members who did not mark yes to supplement use were coded as not using supplements. Some of these subjects may have skipped the questions all-together however there was no distinction provided in the data dictionary. Further analysis is needed on continuous data to more precisely identify the correlation between supplement use, physical performance and health.

### **Conclusion**

This study has practical application to Air Force and military policy. The popularity of dietary supplements continues to increase and this may be, in part due to the perception that they improve health and physical performance. This study however, did not find any significant association between overall supplement use and improved physical performance, reflected on the Air Force Physical Fitness Test or improved health, indicated by fewer medical visits during deployment. This study did highlight that the prevalence of Air Force supplement use is high among all demographics. Predominantly, enlisted members and members who are categorized as overweight and obese are more likely to use supplements. The limited information on the efficacy and safety of many of these supplements used alone or in combination warrants further study. Furthermore, to ensure proper nutrition and dietary intake, members should consult their health care provider before starting a dietary supplement regiment.

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**Appendix A: IRB Exemption**

**DEPARTMENT OF THE AIR FORCE**  
AIR FORCE RESEARCH LABORATORY  
WRIGHT-PATTERSON AIR FORCE BASE OHIO 45433

MEMORANDUM FOR USAFSAM/ PHR (MSGT MICHAEL J. BELL)

FROM: 711 HPW/IR (AFRL IRB)

SUBJECT: IRB approval for the use of human volunteers in research

1. Protocol title: Air Force Fitness and Deployment Health Associated with Supplementation Use
2. Protocol number: FWR20150018E
3. Protocol version: N/A
4. Risk: N/A
5. Approval date: 2 December 2014
6. Expiration date: N/A
7. Scheduled renewal date: N/A
8. Type of review: Exempt
9. Assurance Number and Expiration Date: N/A
10. CITI Training: Completed
11. The above protocol has been reviewed and determined to be exempt from IRB oversight. The goal of the study is to determine if there is an association between supplement use and Air Force Fitness Test scores. The study will examine if supplement use reported on the annual Preventive Health Assessment is associated with better performance on the annual Air Force fitness test. Additionally, the study will look at supplement use associated with overall health as self-reported on post-deployment health questionnaires. The aggregated results will be published in the form of abstracts and/or manuscripts.
12. The data to be used is from a time frame of 1 January 2012 through 31 December 2013 and already exists in Air Force data bases. The Data Manager of the databases will conduct a retrospective data pull and will deliver only fully de-identified data to the Principle Investigator for analysis. This protocol therefore meets the criteria for exemption in accordance with 32 CFR 219.101 (b)(4) which exempts "Research, involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the

information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.”

13. HIPAA authorization is not required, since no HIPAA protected information will be recorded in the execution of this protocol.
14. FDA regulations do not apply since no drugs, supplements, or unapproved medical devices will be used in this research.
15. This exemption applies only to the requirements of 32 CFR 219, DoDI 3216.02, AFI 40-402, and related human research subject regulations.
16. With this approval comes the expectation that the Principle Investigator has the funding to fully execute the protocol. Partial protocol funding, particularly with Greater than Minimal Risk studies, should prompt a re-examination of the protocol by both the Principle Investigator and the IRB with specific emphasis on the risk-benefit evaluation.
17. Any serious adverse event or issues resulting from this study should be reported immediately to the IRB. Amendments to protocols and/or revisions to informed consent documents must have IRB approval prior to implementation. Please retain both hard copy and electronic copy of the final approved protocol and informed consent document.
18. The IRB must be notified if there is any change to the design or procedures of the research to be conducted. Otherwise, no further action is required. All inquiries and correspondence concerning this protocol should include the protocol number and name of the primary investigator.
19. For questions or concerns, please contact the IRB administrator, Lt Eric Ferguson at [william.ferguson@us.af.mil](mailto:william.ferguson@us.af.mil) or (937) 904-8094. All inquiries and correspondence concerning this protocol should include the protocol number and name of the primary investigator.

**WARREN.RICHARD.1228815418**

RICHARD WARREN, PhD  
Exempt Determination Official, AFRL IRB

Digitally signed by  
WARREN.RICHARD.1228815418  
DN: c=US, o=U.S. Government, ou=DoD,  
ou=PKI, ou=USAF,  
cn=WARREN.RICHARD.1228815418  
Date: 2014.12.02 15:02:49 -05'00'



**Appendix B: Department of Defense Form 2796 Post Deployment Health Assessment (pg 2)****This form must be completed electronically. Handwritten forms will not be accepted.**

Deployer's SSN (Last 4 digits): \_\_\_\_\_

1. Overall, how would you rate your health during the PAST MONTH?  
☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor
2. Compared to before this deployment, how would you rate your health in general now?  
☐ Much better now than before I deployed  
☐ Somewhat better now than before I deployed  
☐ About the same as before I deployed  
☐ Somewhat worse now than before I deployed  
☐ Much worse now than before I deployed  
Please explain: \_\_\_\_\_  
Please explain: \_\_\_\_\_
3. How often did you smoke tobacco (for example cigarettes, cigars, pipe, or hookah) during your deployment?  
☐ Just about every day ☐ Some days ☐ Not at all
4. Were you wounded, injured, assaulted or otherwise hurt during your deployment? ☐ Yes ☐ No  
If yes, are you still having any problems or concerns related to this event? ☐ Yes ☐ No  
If yes, please explain: \_\_\_\_\_
5. During your deployment:  
a. Did you ever feel like you were in great danger of being killed? ☐ Yes ☐ No  
b. Did you encounter dead bodies or see people killed or wounded during this deployment? ☐ Yes ☐ No  
c. Did you engage in direct combat where you discharged a weapon? ☐ Yes ☐ No
6. How many times during your deployment did you visit a health care provider for a medical or dental health problem/concern?  
☐ No visits ☐ 1 visit ☐ 2-3 visits ☐ 4-5 visits ☐ 6 or more
7. During this deployment did you receive care for combat stress or a mental health problem/concern? ☐ Yes ☐ No  
If yes, please explain: \_\_\_\_\_
8. During this deployment, did you have to spend one or more nights in a hospital as a patient? ☐ Yes ☐ No  
Reason/dates: \_\_\_\_\_
9. During the PAST MONTH, how difficult have physical health problems (illness or injury) made it for you to do your work or other regular daily activities?  
☐ Not difficult at all ☐ Somewhat difficult ☐ Very difficult ☐ Extremely difficult
- 10.a. During this deployment, did any of the following events happen to you? (Mark all that apply)
- (1) Blast or explosion (e.g., IED, RPG, EFP, land mine, grenade, etc.)? ☐ Yes ☐ No  
If yes, please estimate your distance from the closest blast or explosion:  
☐ Less than 25 meters (82 feet)  
☐ 25-50 meters (82-164 feet)  
☐ 50-100 meters (164-328 feet)  
☐ More than 100 meters (328 feet)
- (2) Vehicular accident/crash (any vehicle including aircraft)? ☐ Yes ☐ No
- (3) Fragment wound or bullet wound?  
a. Head or neck ☐ Yes ☐ No  
b. Rest of body ☐ Yes ☐ No
- (4) Other injury (e.g., sports injury, accidental fall, etc.)? ☐ Yes ☐ No
- If yes to any of the above, please explain: \_\_\_\_\_
- 10.b. As a result of any of the events in 10.a., did you receive a jolt or blow to your head that IMMEDIATELY resulted in:
- (1) Losing consciousness ("knocked out")? ☐ Yes ☐ No  
If yes, for about how long were you knocked out?  
☐ Less than 5 min ☐ 5-30 min ☐ more than 30 min
- (2) Losing memory of events before or after the injury? ☐ Yes ☐ No
- (3) Seeing stars, becoming disoriented, functioning differently, or nearly blacking out? ☐ Yes ☐ No
- 10.c. How many total times during this deployment did you receive a blow or jolt to your head?  
(only answer if you had a yes to any of the questions on 10.a.)  
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ more than 3 (list number of times) \_\_\_\_\_

## Appendix C: List of Competencies Used in CE

### Tier 1 Core Public Health Competencies

<b>Domain #1: Analytic/Assessment Skills</b>
Describes factors affecting the health of a community (e.g., equity, income, education, environment)
Applies ethical principles in accessing, collecting, analyzing, using, maintaining, and disseminating data and information
Uses information technology in accessing, collecting, analyzing, using, maintaining, and disseminating data and information
Selects valid and reliable data
Selects comparable data (e.g., data being age-adjusted to the same year, data variables across datasets having similar definitions)
Identifies gaps in data
Collects valid and reliable quantitative and qualitative data
Describes public health applications of quantitative and qualitative data
Uses quantitative and qualitative data
Explains how community health assessments use information about health status, factors influencing health, and assets and resources
Describes how evidence (e.g., data, findings reported in peer-reviewed literature) is used in decision making
<b>Domain #2: Policy Development/Program Planning Skills</b>
Identifies current trends (e.g., health, fiscal, social, political, environmental) affecting the health of a community
Gathers information that can inform options for policies, programs, and services (e.g., secondhand smoking policies, data use policies, HR policies, immunization programs, food safety programs)
Describes implications of policies, programs, and services
<b>Domain #3: Communication Skills</b>
Conveys data and information to professionals and the public using a variety of approaches (e.g., reports, presentations, email, letters)
Describes the roles of governmental public health, health care, and other partners in improving the health of a community
<b>Domain #4: Cultural Competency Skills</b>
Describes the concept of diversity as it applies to individuals and populations (e.g., language, culture, values, socioeconomic status, geography, education, race, gender, age, ethnicity, sexual orientation, profession, religious affiliation, mental and physical abilities, historical experiences)
Describes the ways diversity may influence policies, programs, services, and the health of a community
<b>Domain #5: Community Dimensions of Practice Skills</b>
Describes the programs and services provided by governmental and non-governmental organizations to improve the health of a community
<b>Domain #6: Public Health Sciences Skills</b>
Recognizes limitations of evidence (e.g., validity, reliability, sample size, bias, generalizability)

### Emergency Preparedness Concentration Competencies

<b>Emergency Preparedness Concentration Competencies</b>
Demonstrate the mastery of the use of principles of crisis and risk management
Use research and/or evaluation science methodologies and instruments to collect, analyze and interpret quantitative and qualitative data
Employ ethical principles in the practice of public health emergency preparedness
Demonstrate an understanding of the protection of worker health and safety